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GROUNDWATER MONITORING REPORT
SEMIANNUAL EVENT – SEPTEMBER 2003
BOEING REALTY CORPORATION
FORMER C-6 FACILITY
LOS ANGELES, CALIFORNIA

by

Haley & Aldrich, Inc.
San Diego, California

for

Boeing Realty Corporation
Long Beach, California

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HALEY & ALDRICH

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Prepared for

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1. INTRODUCTION

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this report on behalf of the Boeing Realty Corporation (BRC) in order to document the Groundwater Monitoring Semiannual Event (2003 Semiannual Event) conducted at the Former C-6 Facility in Los Angeles, California (Site).

The 2003 Semiannual Event was conducted at the Site from September 22nd to the 24th, 2003 in accordance with the "Groundwater Monitoring Workplan 2003" dated 9 December 2002 (Haley & Aldrich, Inc., 2002a). The program included the following activities:

- Groundwater elevation measurements in 22 wells;
- Groundwater samples from 11 wells and subsequent analysis for volatile organic compounds (VOCs) by US Environmental Protection Agency (EPA) Method 8260B; and
- Monitored natural attenuation (MNA) parameter measurements in 11 wells for dissolved oxygen (DO), oxidation-reduction potential (ORP), pH, conductivity, and temperature.

This report provides documentation and discussion of the 2003 Semiannual Event.

2. SITE BACKGROUND

2.1 Site Location

The Site is located at 19503 South Normandie Avenue, in Los Angeles, California. The Site occupies approximately 170 acres, and is bound on the north by 190th Street; on the east by Normandie Avenue; on the west by the former Industrial Light Metals (ILM) facility; and on the south by the former Montrose Chemicals facility and a residential area. A Site location plan is included as Figure 1; a Site plan as Figure 2.

2.2 Site History

The Site was reportedly used for manufacturing aircraft and aircraft parts for 40 years, between 1952 and 1992. Prior to that, industrial use included aluminum and steel production; before 1940, it was farmland. A limited amount of assembly and warehouse related activities continued through the year 2000. Since then, the remaining buildings and infrastructure have been demolished and removed, and the Site is in various stages of redevelopment.

Groundwater investigation activities began in 1987. Forty-three groundwater monitoring wells have been installed. Twenty-one of these 43 wells have since been removed as a result of redevelopment. Prefixes for Site groundwater monitoring wells include BL, DAC, WCC, TMW, and XMW. Groundwater monitoring well details are compiled in Table I.

2.3 Regional Geology and Hydrogeology

A description of the geology and hydrogeology of the region surrounding the Site is drawn from reports published by the U.S. Geological Survey (USGS) (Poland and others, 1959) and the California Department of Water Resources (DWR, 1961). Reference is also made to previous Site reports prepared by Kennedy/Jenks Consultants (Kennedy/Jenks Consultants, 2000).

The Site is located on a broad plain, approximately 52 feet above mean sea level (MSL). The USGS and DWR define this area as the Torrance Plain, a Pleistocene-age marine surface and subdivision of the West Coast Basin/Coastal Plain of Los Angeles and Orange Counties. The ground surface is generally flat, with an eastward gradient of approximately 20 feet per mile (less than one-half percent). Surface drainage is generally toward the Dominguez Channel, approximately one mile to the east. The Dominguez Channel flows southeastward, toward the Los Angeles and Long Beach Harbors, in San Pedro Bay.

The West Coast Basin includes a thick sequence (up to 13,000 feet) of marine and continental sediments (Miocene to Recent) deposited in a broad synclinal depression over a basement

complex of igneous and metamorphic rocks. The uppermost sequence of deposits of interest within the West Coast Basin is as follows:

Youngest	Active Dune Sand
↑	Alluvium
	Older Dune Sand
↓	Lakewood Formation (upper Pleistocene)
Oldest	San Pedro Formation (lower Pleistocene)

The dune sands and alluvium are not present at the Site. The Lakewood Formation is mapped at the surface in the Site vicinity.

The Lakewood Formation (DWR, 1961) includes the upper Pleistocene deposits located in the sediments of the Los Angeles Coastal Plain area. These deposits are marine and continental in origin, and represent stream transport and sedimentation along the Pleistocene marine plain. In the Site area, the Lakewood Formation may also include the Semi-perched Aquifer, the Bellflower Aquitard, and the Gage Aquifer, though based on correlations between Site stratagraphic and adjacent site data, it appears that the Semi-perched Aquifer is absent from the Site itself. The Bellflower Aquitard is a heterogeneous mixture of continental, marine, and wind-blown sediments, consisting mainly of clays with sandy and gravelly lenses (DWR, 1961). The elevation of the base of the Bellflower Aquitard is at about -100 feet MSL, or about 150 feet below ground surface (bgs) in the Site area. The Gage Aquifer is a water-bearing zone of fine-to-medium sand and gravel confined by the Bellflower Aquitard. It is reported to be approximately 40 feet thick in the Site area.

The Lakewood Formation is underlain by the Lower Pleistocene San Pedro Formation, approximately 1,000 feet bgs in the Site area. The major water-bearing zones within the San Pedro Formation are the Lynwood Aquifer and the Silverado Aquifer. These are reported in the Site area at approximately 300 and 500 feet bgs, respectively (DWR, 1961). The Silverado Aquifer is an important groundwater source in the Coastal Plain, and considered a source of drinking water (DWR, 1961).

2.4 Site Geology and Hydrogeology

2.4.1 Geology

Groundwater monitoring wells and soil borings drilled encountered the Lakewood Formation. Monitoring well borings were drilled from the ground surface to depths ranging from 79 to 140 feet bgs. The top 20 to 50 feet below the Site consisted of mainly fine-grained soils (predominantly silts and clays) that become thicker to the east. A sandy zone that dips downward to the east underlies the fine-grained soils.

The sandy zone is generally 80 to 100 feet thick, and contains interbedded layers of fine-grained sediment that also dip down to the east.

2.4.2 Hydrogeology

Groundwater samples from monitoring wells have been collected and analyzed on a regular basis since 1987. The uppermost groundwater appears to be under water table conditions at elevations of approximately -12 to -16 feet MSL (64 to 68 feet bgs). Regionally, this uppermost groundwater appears to be within relatively permeable sediments of the predominantly fine-grained Bellflower Aquitard. Most of the monitoring wells completed in the Bellflower Aquitard are at or near the water table, with screened depths ranging from approximately 58 to 91 feet bgs. Two deeper wells, WCC-1D and WCC-3D, were completed in a deeper zone with screened depths from approximately 120 to 140 feet bgs. Both of these wells have since been abandoned (Table I).

The following primary hydrogeologic units were recognized in the general vicinity of the Site:

FORMATION	HYDROSTRATIGRAPHIC UNIT	
Lakewood Formation (Upper Pleistocene)	Bellflower Aquitard	Upper Bellflower Aquitard (UBF)
		Middle Bellflower Aquitard (MBF, MBFM, MBFC, MBFB)
		Lower Bellflower Aquitard (LBF)
	Gage Aquifer (GAGE)	
San Pedro (Lower Pleistocene)	Gage Lynwood Aquifer (GLA)	
	Lynwood Aquifer (LYNWOOD)	
	Unnamed Aquifer	
	Silverado Aquifer	

The relatively fine-grained Upper Bellflower Aquitard (UBF) is continuous across the area, but thins to the northwest. The UBF is comprised of laminated-to-massive yellowish brown muds, with local sands and fossiliferous zones. The UBF is found beneath the Site, approximately 70 feet thick. A generalized geologic cross-section is included as Figure 3.

The Middle Bellflower Aquitard (MBF) is a massive, light yellowish brown, fine to medium sand, with local muddy zones. An extensive mud layer, referred to as the Middle Bellflower Mud (MBFM), locally interrupts this sand. Where divided, the sand subunits are referred to as the B-Sand (MBFB) and C-Sand (MBFC). The top of the MBFB is found at an approximate elevation of -12 to -20 feet MSL (64 to 72 feet bgs), and is generally from 25 feet to 40 feet thick. The MBFM is discontinuous

across the area, and comprised of laminated silts, layered silts, and very fine sands. Deeper borings at the former ILM facility and the Site do not always encounter the MBFM. The top of the MBFC is found at an approximate elevation of -45 to -55 feet MSL (97 to 107 feet bgs) at the Site (Figure 3).

The fine-grained Lower Bellflower Aquitard (LBF) is reported continuous across the area. The top of the LBF occurs at an approximate elevation of -62 to -98 feet MSL (114 to 150 feet bgs), and ranges in thickness from 10 to 25 feet thick (Figure 3). The LBF separates the Bellflower sands from the underlying Gage Aquifer. The Gage Aquifer in the Site vicinity is predominantly sand, and ranges in thickness from 40 to 78 feet. No monitoring wells have been drilled into the Gage Aquifer at the Site (Kennedy/Jenks Consultants, 2000).

3. GROUNDWATER SAMPLING PROCEDURES

3.1 Monitoring Plans

The 2003 Semiannual Event was conducted from September 22nd to the 24th, 2003, by Tait Environmental Management, Inc. (TEM) field personnel. Work was conducted in accordance with the following documents:

- *Groundwater Monitoring Workplan 2003*, by Haley & Aldrich, Inc., dated 9 December 2002, approved by the Los Angeles Regional Water Quality Control Board (LARWQCB) on 23 January 2003.
- *Standard Operating Procedure, Groundwater Gauging and Sampling*, prepared by Tait Environmental Management, dated 9 September 2002.

Monitored natural attenuation sampling was conducted according to:

- *Standard Operating Procedures for Measuring Natural Attenuation Parameters at Boeing Realty Corporation Former C-6 Facility, Revision 1.0*, prepared by Haley & Aldrich, Inc. and England Geosystem Inc., dated 9 January 2001.

Activities performed during the 2003 Semiannual Event were as follows.

3.2 Groundwater Elevation Measurement

- Water levels were measured in 21 Site groundwater wells on the 22nd and 24th of September 2003 (Table II).
- A groundwater elevation contour map was generated based on these measurements (Figure 4).

3.3 Well Purging, Sampling and Analysis

- At least 3 wetted casing volumes of water were purged with a submersible pump from each well.
- Purge water was monitored for pH, temperature, and specific conductivity stability.
- Purging was completed when a minimum of three wetted casing volumes were removed and three consecutive measurements of pH, temperature, and specific conductance were within 10% of each other, or after five casing volumes were purged.

- Groundwater samples were collected from 11 wells with a submersible pump and analyzed for VOCs by EPA Method 8260B.
- QA/QC samples were also collected and analyzed for VOCs by EPA Method 8260B.

3.4 Monitored Natural Attenuation (MNA) Parameters

- MNA parameters (DO, ORP, and pH) were measured in the field.

3.5 Field Procedures

Field procedures for this Semiannual Event are outlined in the documents listed previously in Section 3.1.

3.6 Sample Naming

Groundwater samples were labeled in the following format, in accordance with the Boeing Data Management Plan (DMP) prepared by CH2Mhill, and dated January 2002 (CH2MHill, 2002):

For example: TMW_01_WG092403_0001

Where:
TMW_01 = the groundwater monitoring well name
WG = Groundwater sample
092403 = date the sample was collected (mmddyy)
0001 = the number of samples taken from the well

3.7 Groundwater Monitoring Program Variances

Groundwater monitoring wells TMW-5 and TMW-16 were scheduled for gauging and sampling during the Semiannual Event; well XMW-09 was scheduled for gauging only. However, due to Site redevelopment construction activities, groundwater monitoring wells TMW-5 and TMW-16 were abandoned. XMW-09 is a Montrose Chemical Company monitoring well and will be sampled once construction activities are complete and access to the well is feasible, expected in the spring of 2004 for the 2004 Annual Event.

4. MONITORING AND SAMPLING RESULTS

4.1 Groundwater Elevations

Field sheets for the data collected by TEM are included in Appendix A. A summary of the groundwater elevations for the 2003 Semiannual Event is presented in Table II.

During the 2003 Semiannual Event, groundwater elevations ranged from –12.61 to –14.47 feet MSL, or approximately 60 to 72 feet bgs. Overall, groundwater elevations have decreased up to approximately 0.54 feet, compared to the values measured in March 2003. The one exception was well TMW-14, which increased approximately 0.02 feet. Historic groundwater levels are presented in Table III.

Figure 4 is a groundwater elevation contour map of the MBFB (B-Sand) water-bearing zone, generated from the data collected from the 2003 Semiannual Event. The average horizontal hydraulic gradient in the MBFB was calculated to be approximately 0.0011 to 0.0016 ft/ft to the south in September 2003, as compared to approximately 0.0008 to 0.0009 ft/ft to the south calculated for March 2003. Based on the groundwater elevation contours shown on Figure 4, the hydraulic gradient varies across the Site along the various flow vectors. The groundwater in the MBFB appears to generally flow in a southerly direction.

4.2 Groundwater Quality - VOCs

Results of VOC analysis by EPA Method 8260B for the 2003 Semiannual Event, conducted in September 2003, are summarized in Table IV, and in Figures 5 and 6. Based on visual observations during well sampling, TEM recorded no indications of dense non-aqueous phase liquid (DNAPL) in any of the sampled wells. Based on a review of previous monitoring reports, general plume geometries for trichloroethene (TCE) and 1,1-dichloroethene (1,1-DCE) appear to be generally unchanged since 1999 (Haley & Aldrich, Inc. and England Geosystem Inc., 2001b and 2001c and Haley & Aldrich, Inc., 2002b, 2002c and 2003). Concentration changes observed appear to have been within range of fluctuations observed in the Site wells over past monitoring events.

TCE

Figure 5 shows the dissolved-phase TCE concentrations in the MBFB. TCE concentrations in groundwater samples have either generally decreased or minimally increased (less than 20%) in nine of the 11 wells sampled, compared to the March 2003 sampling event, with the exception of two wells:

- TMW-1 - TCE increased from 860 to 1,100 micrograms per liter (µg/l); and

- TMW-2 - TCE decreased from 14,000 to 7,900 µg/l.

1,1-DCE

Figure 6 shows the dissolved-phase 1,1-DCE concentrations in the MBFB. 1,1-DCE concentrations in groundwater samples have generally stayed the same or decreased in the monitored wells. 1,1-DCE was not detected at DAC-P1, TMW-10, TMW-11 and TMW-14.

Tetrachloroethene (PCE)

Three wells were reported with detectable concentrations of PCE up to 1.6 µg/l (TMW-14). Two of these concentrations were at low levels that could not be quantified by the laboratory, and are noted in Table IV with a "J" flag.

1,1,1-trichloroethane (1,1,1-TCA)

Concentrations of 1,1,1-TCA were detected in one of the 11 wells sampled (TMW-2). From the March 2003 to the September 2003 sampling events, concentrations of 1,1,1-TCA decreased in well TMW-2, from 1,300 µg/l to 600 µg/l.

Other VOCs

As in previous sampling events, some minor occurrences of VOCs other then those described above were detected, and are tabulated on Table IV. These VOCs occurrences included cis-1,2-DCE, chloroform, methyl ethyl ketone (MEK) and toluene, and are discussed below.

- Cis-1,2-DCE concentrations in groundwater generally remained the same (20% variances or less) in the 11 wells sampled, except in the following two wells: DAC-P1 (from 89J to 120J µg/l) and TMW-2 (from 4,700 to 10,000 µg/l). These values are within the historical range of fluctuation for each well, as shown on Table V.
- Chloroform concentrations in groundwater samples have generally remained the same (less than 20% variances) in the 11 wells sampled. Chloroform was detected in five wells at concentrations up to 440 µg/l, and the values reported are within historical range of fluctuation for each well, as shown on Table V.

- MEK (2-butanone) was detected in only one well (TMW-2). Well TMW-2 was reported to have an MEK concentration of 70,000 µg/l, which increased from below laboratory detection limits (< 1,200 µg/l) in March 2003. Well TMW-2 demonstrated a similar concentration change during the March and September 2002 sampling events.
- Toluene was detected in two wells: TMW-2 (2,500 µg/l) and WCC-5S (0.92J µg/l). The values reported are within historical range of fluctuation for each well, as shown on Table V.

Field MNA Parameters

Field monitoring of DO, ORP, and pH was conducted during the 2003 Semiannual Event. A summary of the September 2003 MNA parameters is included in Table VI, and on the Field Data Sheets in Appendix A. These parameters are generally similar to the September 2002 semiannual event data, and suggest that in-situ conditions have not changed. The distribution of DO and ORP suggests evidence of intrinsic biotransformation of VOCs in the potential source area near former Buildings 1/36 and 2, as well as along the southern property boundary. It appears that DO has been depleted within the areas of TCE and 1,1-DCE-impacted groundwater. ORP is negative within the Building 1/36 area (TMW-2), suggesting anaerobic reducing conditions.

5. QUALITY ASSURANCE/QUALITY CONTROL

Several field quality control samples were collected during the Semiannual Event. These included:

- Field duplicates;
- Equipment rinsate blanks;
- Field blanks; and
- Trip blanks

These quality control samples are described below.

5.1 Field Quality Control Samples

5.1.1 Field Duplicates

One duplicate groundwater sample was analyzed for VOC concentrations from well TMW-7. These results are included in Table IV. Duplicate laboratory data can be used to measure how well replicate measurements reproduce, and also to estimate overall method precision. Relative percent difference (RPD) is a measure of precision, and is calculated as follows:

$$(\text{Result 1} - \text{Result 2}) / \tfrac{1}{2} (\text{Result 1} + \text{Result 2}) * 100\%$$

The RPD will often vary with the concentration of analyte; RPD lessening as the concentration increases. If the variation is greater than plus or minus 15%, but less than 100%, the reported concentrations are up to standard. If the variation is greater than 100%, the data is subject to further evaluation (i.e., comparison with historic data from the well). The data from TMW-7 and the TMW-7 duplicate were reported to have RPDs less than or equal to 30%, with the exception of cis-1,2-DCE which had an RPD of 200%. The detected concentration of cis-1,2-DCE is 15J µg/l, which has a "J" flag and could not be quantified by the laboratory (detection limit is 50 µg/l). Therefore, the RPD of 200% for cis-1,2-DCE is relatively insignificant and the reported concentrations are up to standard.

5.1.2 Equipment Rinsate Blanks

Two equipment rinsate blanks were collected during the Semiannual Event after cleaning the sampling equipment with deionized water. These rinsate samples were

analyzed for VOCs by EPA Method 8260B. Estimated concentrations of acetone (up to 7J µg/l) were detected below the contracting laboratory reporting limit (10 µg/l) in both equipment blanks. MEK was also detected in the equipment blank collected on 24 September 2003 at a concentration of 8.8 µg/l, as shown on Table IV.

5.1.3 Field Blanks

Two field blanks were collected during the Semiannual Event with laboratory-supplied water to check for contamination by sampling methodology. These field blank samples were analyzed for VOCs by EPA Method 8260B. In the field blank from 24 September 2003, acetone and MEK were detected at concentrations of 13 and 9.3 µg/l, respectively, as shown on Table IV.

5.1.4 Trip Blanks

One laboratory-prepared trip blank was shipped to the laboratory each day to check for cross-contamination. The samples were analyzed for VOCs by EPA Method 8260B. Estimated concentrations of acetone (3.6J and 6.2J µg/l) were detected below the contracting laboratory reporting limit (10 µg/l) in the two trip blanks, as shown on Table IV.

5.1.5 Data Validation and Laboratory QA/QC Samples

Final laboratory-certified reports and laboratory quality control procedures are included on the compact disc (CD) as Appendix B.

Sixty-three percent of the samples (7) were validated. Tier I data validation was performed on 63% of the samples (7); Tier II data validation on 45% of the samples (5); Tier III data validation on 5% of the samples (1). Based on these data validation results, the data collected during this event is adequate for continued characterization and monitoring of VOCs in groundwater beneath the Site. Data validation results are provided in Appendix C. Appropriate data qualifiers, as determined by Laboratory Data Consultants, Inc. (LDC) (data validation subcontractor), have been included where appropriate.

6. LIMITATIONS

This report was prepared by Haley & Aldrich under the professional direction and review of the registered professionals listed on the cover page. The work described herein was conducted in accordance with generally accepted professional engineering and geologic practice. No other warranty exists, either expressed or implied.

In addition to data collected by and observations made by Haley & Aldrich personnel, this report incorporates Site conditions observed and described by others as reported in records available to Haley & Aldrich as of the date of report preparation. Haley & Aldrich relied—in part—on such data collected by others in the development of interpretations about environmental conditions at the Site. The accuracy, precision, or representative nature of data originally generated by others could not be independently verified by Haley & Aldrich and would be beyond the scope of this project.

In addition, the passage of time may result in changes in Site conditions, technology, or economic conditions which could alter the findings and/or recommendations of the report.

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